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ABSTRACT

This study focuses on the school district decision to initiate an innovative program. A natural experiment in the identification of school districts interested in initiating serious innovation is used to study the differences between school districts that were and those that were not considering innovation in one specific decisionmaking period. In late 1970 the U.S. Office of Education offered every school district an opportunity to receive a substantial grant if the district had a serious and well-planned innovative school program. In this study, the districts that applied are "initiators," and the districts that did not submit grant applications are "noninnovators." The model uses indicators of economic, organizational, and political phenomena to "predict" whether or not each of the sample districts applied for the federal innovation grant. Variables used in the analysis are: grant application, school enrollment, central city or suburban character of the district, poverty measure, board of education selection, and the number of calendar years elapsed since each district's 1970 superintendent of schools was appointed. (Author/MLF)

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DECISIONS TO INNOVATE: A MODEL OF SCHOOL ORGANIZATIONS AND SECTION 306, TITLE III

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PREFACE

Research on innovation in education has largely centered on the problem of adoption--why are some school districts quick, and others slow, to adopt new programs? Berman and McLaughlin, in *A Model of Educational Change* (R-1589/1), have proposed a framework for understanding the innovation process which makes it clear that politico-economic decisions at various points in the process are crucial to the outcome of the innovation. This study focuses on the decision to initiate an innovative program. It takes an exploratory approach to testing the impact of a few organizational, economic, and institutional variables on the decision to pursue change.

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Two helpful, knowledgeable, and thoughtful friends in the Office of Education made this project possible by introducing me to the Section 306 program and securing the records which I needed. They are Ms. Jean Narayanan and Ms. Nancy Taylor, and I give them my thanks. Alan Ginsberg, Lee F. Wickline, and Jeff Williams also contributed to the success of my stay in Washington.

At Yale and Rand, several people have made this a better essay (though I do not blame them for its shortcomings). Paul Berman helped me prepare the research design. Barry Margolin of the Department of Statistics made essential and provocative suggestions for my data analysis. I had very useful conceptual discussions with Peter Busch, Richard Murnane, Suzanne Weaver, and Douglas Yates.

DECISIONS TO INNOVATE: A MODEL OF SCHOOL ORGANIZATIONS AND SECTION 306, TITLE III

What social structure underlies the initiation of new program proposals in the American education system? This essay on the roots of decisions to innovate in the public schools has two goals: to discover why some school organizations cope creatively with the economic, political, social, and cognitive demands which most of them face, and to use the analysis of innovation in school systems as a guide to theories for explaining innovative policy-making behaviors of other public organizations. Schools are unique and crucial in our society; the ways in which they adapt to new social conditions--to new structures, goals, and crises--demonstrate the possibilities and limitations of many "interventionist" and "activist" approaches to community problems. And as government decisions transfer the formerly decentralized activities of private institutions to public organizations, a causal theory to explain what public organizations decide to do and why they do so is increasingly important to an understanding of American society.

To uncover and explain the initiation of new programs in the public schools, we must face innovation as a policy problem and as a research problem. Any analysis of innovation as a policy outcome in school systems must explicitly consider the possibility that not all innovation is good--that an innovation may fail to attain its own expressed goals, not to mention the possibility that it might upset delicate school or community institutions. The fact that innovations vary greatly with regard to the clarity and consciousness with which they are agreed upon, or rejected, is a fact of policy-making. The heuristic concepts of the *need* for a change, the *goals* of an innovation, and even the notion of what a *policy change* is, are interpreted very differently by different organizations responsible for policy. The complexity and chaos facing decision-makers--the problem of the crowded agenda--imply that a great many decision

processes are going on at the same time as the consideration of a possible innovation. A causal analysis of innovation as a policy outcome must consider that the real behaviors associated with innovation are simply not the same as the reforms called for and assumed by progressive educators citing innovation as a general solution to the assorted failures of American schooling.

The central research problems of an inquiry into innovation decision-making are those of our assumptions, and of the use of analytic tools to expose interesting phenomena in our data (whether it is impressionistic or concrete). Is there an underlying structure which accounts for innovative behaviors, or is our collection of sample "innovations" just a disparate agglomeration of behaviors which grow out of specific responses to personnel, to hierarchy, or to the substance of an educational issue? In exploratory work, our answer must be as much careful argument as empirical display; it is not obvious that innovation decisions are a discrete, studiable class of events. The issue of presumed structure requires many research decisions. For example, what is to be our definition of "initiation decisions," and how are they related to the class of all policy decisions? How can we know that innovations are homogeneous enough to permit analysis and generalization--that there are not several structures in the group of events we seek to understand? How does our choice between aggregate and case analysis constrain our findings? Is the proper notion of program initiation an imaginary scale of "propensity to innovate," from high to low; or an organization-classification problem, either initiating or not; or some other guessed heuristic? And does our research capture *causes* of initiation, or simply correlated characteristics which leave us ignorant of what provokes, influences, or promotes innovation? These questions are not unique to research on innovation. Two aspects of the present problem bring them into force: first, initiation-decision research must *explore* unknown possibilities in some set of data, rather than determine whether or not a carefully selected data set confirms some well-defined and clearly specified

hypotheses; and second, research which is aimed at making suggestions about the behavior of many kinds of public organizations in many circumstances must *explore* alternative assumptions in order to generalize from a particular analytical setting. This study is an attempt at exploratory analysis--with all of its concomitant alternative explanations, tentative results, unprovable suggestions, and reservations for future research--which will be as explicit as possible about its leaps and assumptions.

The sort of program initiation which we will study may be defined as any policy change which, when implemented, results in substantial change in the behavior of some school system participants (including students, teachers, or headquarters staff), thereby changing the way the school system--or some part of it--works. We will examine some claims about the roots of innovative programs by studying some possible causes of an interesting natural experiment in national education policy which occurred in 1970-71. The claim that our findings actually reflect some coherent and relevant causes of innovative behaviors must, of course, be carefully argued.

In late 1970 the U.S. Office of Education offered each school district an opportunity to receive a substantial grant if the district had a serious and well-planned innovative school program. The federal grant program's ostensible purpose was to select and support some promising new techniques and approaches to education, but the grant-application procedure provided a litmus test of every school district's desire in 1970 to introduce some new, serious, locally planned program change. For our purposes, a test of commitment to innovation was applied to all school districts in late 1970; we may now study the districts which behaved as "initiators" according to our test, and may also study the presumed "non-innovators" who did not submit grant applications.

The litmus test was actually the first round of grant applications conducted under Section 306 of Title III of the Elementary and Secondary Education Act of 1965. ("Section 306" and "Title III" are used interchangeably to refer to the innovation grant program.)

A product of the 1970 Amendments to the Act, Section 306 gave the Office of Education the authority to conduct a competition among school districts to identify and fund

> ...*innovative* and *exemplary* projects which hold promise of making a substantial contribution to the solution of critical educational problems....[1]

Congressional hearings had attached some conditions to the competition: that there would be "winners" in every state, that some projects would be relevant to national concerns, and that multi-year funding commitments would be made to participating school districts. After passing the education amendments, Congress failed to pass corresponding appropriations until November 1970--leaving little time for the selection and preparation of projects for the school year beginning in September 1971. On December 10, 1970, the Office of Education mailed a letter to each superintendent of schools, inviting him or her to apply for a grant to support innovation--and enclosing a 25-page application blank which was due no later than February 1, 1971. Grants were to average $150,000 per year for three years, and no local contribution beyond normal per-pupil expenditures was required. The need for change and the nature of local problems were to be locally measured, and evaluations of a project's eventual success were to be conducted by local professionals locally chosen (though not chosen by or part of the innovative project staff itself). The application form required evidence of substantial local planning, the involvement and expressed preferences of some community members, and a narrative description of the goals, methods, and proposed extent of the innovative proposal. The probability that competition for grants would be stiff--that is, that there would be many high-quality applications for a limited number of grants--was made clear in the December 10 letter. The first evaluation of the proposals was to be conducted by the Office of Education, which would "weigh the seriousness of the problem to be dealt with and the comprehensiveness of the proposed solutions."[2]

The first round of the Section 306 application process resulted in 817 applications being submitted to the Office of Education.

ANALYZING THE NATURAL EXPERIMENT

Can we infer, from the way the Section 306 application process was conducted, what sort of natural experiment it constituted? Let us consider the Section 306 process as a discriminator among districts, as an identifier of innovations, and as a potential intervention in the local policy-making process.

I. The brief time allowed for submitting the Section 306 application probably diminished the effects of grantsmanship--six weeks is simply a very short time to allow the formulation of a competitive proposal for innovation if none had been contemplated. The requirement for clear evidence of prior planning and community involvement reinforces this constraint on grantsmanship. Because the grant competition occurred at a specific time, the applications submitted represent specific, on-going local *decisions*--not community inclinations, attitudes, or self-evaluations. The grant process captures a specific behavior which was explicitly relevant to innovative, "exemplary and demonstration"[3] project decisions in the schools. Since a specific behavior is at the center of our analysis of a natural experiment, we may clearly *discriminate* among districts which did and did not apply for Section 306 funds.

II. Section 306 identified a class of districts interested in change. We can infer from the requirements of the grant application form received by all school districts that all applicants believed their proposals to be serious in intent and scope, competitive with other districts in quality, and relevant to locally defined needs--if and only if we think that the applying and non-applying districts believed the Office of Education's description of the program. There is little reason to question this assumption for the applying districts (a review of all completed applications, and interviews with the Title III staff, confirm this judgment[4]), and the consequences of a partial failure of non-applying districts to react to

the grant offer as we have inferred will be discussed later. The fact that school districts were not required to propose projects which performed some specific mission determined in Washington--say, to propose projects for instruction in foreign languages, or for performance contracting--left the definition of innovation to each district. Identifying what was important and different and useful depended on the school district organization itself, and if each applying district organization was confident of the value of its proposal, we may use the proposals to *identify* local decisions to innovate.

III. Whether we think the Section 306 application process captured most districts pursuing innovation in 1970-71 depends on our evaluation of the grant concept as an intervening event in the progress of local school decision-making. Most school districts are chronically short of funds--especially the marginal, discretionary, and uncommitted funds required to implement an innovative proposal which diverges significantly from normal resource allocation. Some studies of innovation have used measures of the "innovative" policies which were actually put into operation, as indicators of the propensity to innovate.[5] (Primarily because these measures confuse innovativeness with the strategic ability to collect and mobilize financial and other resources for implementation, studies such as Alford's and Aiken's "Community Structure and Innovation" have shown disappointing and theoretically inexplicable results.) In public schools, the financial difficulties in implementing an alternative high school or a teaching-machine-based curriculum are great, and there is divergence between a district's commitment to solving local problems through innovation and its fiscal ability to do so (especially when fiscal decisions are considered as short-run allocations by decision-makers who are likely to be highly conscious of the problems of getting new revenues). Because a successful Title III application would result in a grant, the applicants did not have to be able financially to afford to implement innovation. They *did* have to consider which possible programs could meet their needs, to have

analyzed and formulated at least a brief narrative plan for the innovative project, and to have secured consent from some relevant political decision-makers in the district (perhaps the superintendent, school board, some principals, and a teacher or union representative). The *intervention* of the new Title III program into school planning in 1970-71 probably resulted in a classification of school districts with regard to their commitment to initiating innovation and to the presence of political consent to change, *without* regard to the perceived fiscal capacity of the districts.

In summary, a 1970 natural experiment in the identification of school districts interested in initiating serious innovation can be used to study the differences between school districts which were and were not considering innovation in one specific decision-making period. While it seems unlikely that each of the approximately 17,000 recipients of the Section 306 application letter decided explicitly whether it was appropriate to complete the application for the grant competition, we need only assume that the invitation to compete favorably captured the attention, and some rather minimal action, from just those districts which would have considered innovation even without the intervention of the Section 306 program. The offer of a substantial, relatively long-range commitment of support funds (with a minimum of federal "strings") for innovation in a time of widespread real and anticipated school fiscal troubles seems quite likely to overcome the organizational inertia which might block the prompt submission of an application--especially if the organization is at least partially focused on a locally initiated innovation anyway.

How does the Section 306 natural experiment in innovation allow us to analyze the causes of policy and program change? We will examine a model which uses indicators of economic, organizational, and political phenomena to "predict" whether or not each of a sample of school districts applied for a federal innovation grant in early 1971. By careful evaluation of the results, we may consider some hypotheses about the processes in each school organization which may have

contributed to the decision to apply--a decision that reflects some prior train of innovation-focused activities (such as search, analysis, formulation of proposals, and the securing of local consent) without implying a capability to support financially the innovation.

Two phenomena in the data on school district innovation may upset the results of this study: there may have been districts represented as not initiating an innovation (non-applicants) who were actually perusing innovation, and there may have been districts represented as initiating an innovation (applicants) who were not actually pursuing innovation. The effect of either error is that, in the limiting case, no true causal variables can be estimated in a valid relation to our measure of the decision to pursue innovation. There are several hypothetical causes for this problem of error in the dependent variable; perhaps grantsmanship led to otherwise inappropriate applications--but the short time for proposal preparation, the requirement for prior community involvement in planning, and the expected competitiveness among seriously applying districts militate against this error. Perhaps some districts considering innovation were put off because of presumed federal "strings" on the grants, or because even substantial increments of new funds were not a budgetary strain--but the Office of Education letter explicitly minimized federal limitations, and the substantial grants could be combined with local extra expenditures to yield a very prosperous project. Perhaps the daily chaos of some school district headquarters caused some superintendents never to be aware of the Section 306 program, despite the tangible gain possible if that district were in fact contemplating a policy or program change. Still, errors in the innovation variable are possible; our evaluation of their extent should influence our interpretation of this essay's findings.

The usefulness of the Section 306 natural experiment as a dependent variable hinges on our assumption that it reflects the presence or absence of a decision to pursue innovation. If we are actually measuring some other phenomenon, then our analysis must fail. For example, if applicants for Title III funds were not serious

in their intent, or did not intend to change the behaviors in some part of the school system, or if a serious application did require the expenditure of substantial funds for grant-preparation (destroying our assumption that fiscal capacity was not relevant to this litmus test of innovation), then our analysis would measure some unknown set of decisions which resulted in Section 306 applications--but decisions which did not reflect innovation. I have briefly reviewed the applications which were submitted to the Office of Education in February 1971, and I have collected the narrative proposal abstracts submitted by each applicant.[6] The applications and abstracts are rich with information. They do not support any of the three possible errors cited above, or any related errors: projects were overwhelmingly serious in intent, broad in scope, but modest in presentation.

A MODEL FOR EXPLAINING INNOVATION

Taking the object of our study, warts and all, for granted, we may consider how to model explanations for the phenomenon of a school district's being able to submit innovative proposals. A broad model might specify the "decision outcome" of whether a school district submitted an innovative proposal, as a function of several kinds of influences:

Decision outcome: submitting an innovative proposal = f{

- The policy preferences of community groups and organization members on particular local issues, as possible stimuli for the consideration of innovations;
- The community economic constraints which may promote or limit the extent to which innovation can be conceived of as a problem-solving device;
- The existence of sufficient executive school headquarters personnel to pursue and develop innovative proposals;

The organizational decision-making structures which promote or hinder innovation processes;

The political structures and events which promote or hinder innovation processes;

The ability of school system personnel to imagine or discover innovative problem-solving schemes; and

The extent to which the consideration of innovation is blocked by a crowded and chaotic political agenda.

This schematic explanation of decisions to innovate as the product of the school organization is a structure equation: it attempts fully to map the true relationships between innovation decisions and their causes. The structure equation summarizes the *a priori* theory to be considered--and partially analyzed and tested--in this essay.* As we discuss specific indicators and possible interpretations of results, we may recall the structure equation as a framework for integrating our hypotheses.

This study will select and analyze the effect on innovation decisions of a small number of variables, without making any pretense of testing the structure equation. Because our goal is to expose the shape of a few relationships and to determine the possibility of characterizing the initiation phenomenon in further study, these limits on the scope of the analysis may prove helpful.

SOME INITIAL DATA SETS FOR EXPLAINING INNOVATION

Before setting out some hypotheses which can be tested in limited "reduced form" equations, we may examine the data sets selected for the exploratory analysis. Information was collected on a sample of school districts which was defined in two ways. First, all school

*The structure equation's specification is supported by a loose and diverse literature, which is discussed in my essay "Innovation in Public Organizations: Dimensions of an Adaptive Process."[7]

districts which applied for Section 306 funds in early 1971 were studied. (There were about 275 applicants for Section 306 funds which were not studied, mostly because they were not school district organizations. These applicants included private entrepreneurs, groups of school districts apparently applying as a unit, and organizations known as, or similar to, "Boards of Cooperative Educational Services." The latter organization typically provides special, vocational, and remedial education on a contract basis to several school districts; California's County School Boards were included in this category of applicants.) Second, a random sample of school districts, selected for statistical research by the Office of Education, was studied. The Office of Education sample, drawn for the Consolidated Program Information Report, was taken from all school districts which existed in 1970 which had an average daily attendance of at least 300; the sample was stratified by enrollment.[8] The 1243 school districts in either or both of these groups--Section 306 applicants and Office of Education sample districts--were studied in the empirical work reported here. This sampling technique overrepresents the Section 306 applicants, and only samples the non-applicants. Such a procedure increases the information available on each "initiating" district without throwing away any information on the Office of Education national sample districts.

Information on whether each school district's school board members were elected or appointed was collected from the Office of Education's 1970 Elementary and Secondary General Information Survey (ELSEGIS).[9] The Census mapping project of the Office of Education produced 1970 Census summary characteristics for school districts; from this data, information on the proportion of children (those eighteen years old or younger) in each school district whose families' incomes were below the Orshansky poverty level ($4000 per year for a family of four, and an adjusted figure for other family sizes) was collected.[10] (All children, not just those enrolled in public schools, were considered in compiling this measure.) The average daily enrollment in the 1970-71 school year was gathered from the

Office of Education's *Education Directory: 1970-71 Public School Systems*.[11] The metropolitan character of each school district was collected by comparing the county in which the superintendent's office was located (from the *Education Directory*) with a list of counties which were part of some Standard Metropolitan Statistical Area (from the 1967 Bureau of the Budget listing, *Standard Metropolitan Statistical Areas*[12]). Two kinds of information were collected: whether the school district's county coincided in part with the central city of some SMSA, and whether the school district's county was a county in an SMSA but was not part of the central city (this datum is sometimes referred to as "suburbanism," for brevity). For example, the Orange County (Florida) School District includes Orlando, the central city of an SMSA; the Seminole County School District is a non-central part of the same SMSA. Information on whether each school district's budget-setting process is independent of, or dependent on, the approval of local municipal authorities was collected from the 1970 ELSEGIS study.[13] Finally, the number of calendar years elapsed since each district's 1970 superintendent of schools was appointed to his or her job was taken from the *1970 Roster of Members*[14] of the American Association of School Administrators.*

Summary characteristics of each variable are displayed in Table 1. Zero-order correlations among the variables, excluding superintendent's tenure, are presented in Table 2a. Zero-order correlations for all variables, including superintendent's tenure--for those observations where information on tenure was available--are presented in Table 2b.

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*Missing data was essentially inconsequential for most variables. The measure of the proportion of children in poverty was not available for a small number of districts, all of which had average daily attendances of fewer than 300; these observations were deleted from the analysis. Because not all school superintendents are members of the American Association of School Administrators, almost one-third of the school districts in the sample had the measure of superintendent's tenure not present. These observations are retained in the analysis, and account will be taken of the missing data problem.

Table 1

SUMMARY CHARACTERISTICS FOR SCHOOL DISTRICT DATA, COMPUTED FOR 1243 OBSERVATIONS AND FOR 840 FULL-INFORMATION OBSERVATIONS

	1243 Observations			840 Observations		
	Mean	Standard Deviation	Range	Mean	Standard Deviation	Range
Initiation	.433	.496	0-1	.496	.500	0-1
Enrollment	14,183	47,882	303-1,123,165	18,677	57,273	330-1,123,165
Central City	.140	.347	0-1	.186	.389	0-1
Suburb	.333	.471	0-1	.331	.471	0-1
Poverty	.150	.124	0-.7741	.134	.107	0-.7222
Fiscal Status	.271	.445	0-1	.270	.444	0-1
Board Selection	.107	.309	0-1	.120	.325	0-1
Superintendent's Tenure	---	---	---	5.960	6.381	0-41

NOTE: The units for these variables are as follows:

1. Initiation coded 1 for proposal submitted; 0 otherwise.
2. Enrollment in students.
3. Central City coded 1; 0 otherwise.
4. Suburb coded 1 for non-core city, metropolitan area; 0 otherwise.
5. Poverty expressed as a proportion between zero and one.
6. Fiscal Status coded 0 for independent; 1 for dependent.
7. Board Selection coded 0 for elected; 1 for appointed.
8. Superintendent's Tenure in years.

Table 2a

ZERO-ORDER CORRELATION COEFFICIENTS,
COMPUTED FOR 1243 OBSERVATIONS

	Initiation	Enrollment	Central City	Suburb	Poverty	Fiscal Status
Enrollment	.160	---	---	---	---	---
Central City	.237	.391	---	---	---	---
Suburb	-.090	-.068	-.285	---	---	---
Poverty	.026	.011	.013	-.408	---	---
Fiscal Status	.055	.103	.072	.022	.081	---
Board Selection	.065	.126	.085	-.068	.176	.099

NOTE: The units and signs used in this table follow those described in Table 1.

Table 2b

ZERO-ORDER CORRELATION COEFFICIENTS, COMPUTED FOR
840 FULL-INFORMATION OBSERVATIONS

	Initiation	Enrollment	Central City	Suburb	Poverty	Fiscal Status	Board Selection
Enrollment	.153	---	---	---	---	---	---
Central City	.230	.377	---	---	---	---	---
Suburb	-.116	-.088	-.336	---	---	---	---
Poverty	.015	.055	.062	-.417	---	---	---
Fiscal Status	.034	.120	.082	-.013	.108	---	---
Board Selection	.028	.133	.059	-.042	.199	.146	---
Superintendent's Tenture	-.210	-.094	-.110	-.025	.055	-.038	.024

NOTE: The units and signs used in this table follow those described in Table 1.

WHAT QUESTIONS CAN WE ANSWER?

How do the variables whose measures we have just described help us to explore the verbal structure equation which we posited to explain innovation decisions made by school organizations? In particular, how can we use our general model to analyze our data? Our knowledge of the substance of innovation decision-making must tell us what to look for in data; the immediate questions which our analysis can answer are whether or not certain explicit, theoretically justifiable hypotheses are *compatible* with the available data and our substantive knowledge of school systems. Hypotheses which relate the variables for which we have collected information to our measure of initiation can then serve as links between the broad verbal model proposed above, and the data set of behaviors in 1243 school districts.

The hypotheses that follow pose the problem of initiation as one which faces all decision-making public organizations--that is, Section 306 application behaviors are held to be relevant to the basic decisions of all school district organizations and to other public institutions. Each hypothesis proposes a link between *the likelihood of a school district organization's being able to submit innovative proposals*, a policy output, and a variety of possible behavioral causes of that output. Whether or not there is evidence for a causal model of innovation decisions in the data depends on inferences and arguments made after the presentation of our results. The hypotheses are grouped according to the independent variable they consider.

I. Submitting innovative proposals depends positively on the size (enrollment) of the school system, because large systems are qualitatively different organizations--in their administrative overhead, professional diversity, complexity of interaction (among both specialists and generalists), and reward structures; these organizational attributes promote innovation.

II. Submitting innovative proposals depends positively on whether the district is in a central city, because
   a. city service organizations are under more pressure to show extraordinary efforts at problem-solving and the

appearance (at least!) of responsiveness; innovation is a solution to this political problem, or

b. cities have more urban and sophisticated staffs and leaderships; such people are likely to innovate.

III. Submitting innovative proposals depends negatively on whether the school system is metropolitan but not a central city, because

a. to the extent that these districts are or have been fast-growing, the organizational incentives for coping with growth are not compatible with programmatic change, or

b. suburban school systems are more likely to be locally perceived as "apolitical" or "professionally run," and thus lack pressures and incentives for change.

IV. Submitting innovative proposals depends negatively on the tenure (in years) of the school superintendent, because

a. a new school superintendent's newly hired personal staff are anxious to show concrete and innovative results (and they lack the power and webs of contacts to show results strictly within the past programs of local school systems), or

b. newer superintendents are under pressure to show fast "results"--but unestablished leaders are less able to work through the selective granting of promotions, hiring practices, arrangements with unions, or delicate coalition-building, and so choose programmatic innovation, or

c. the newer superintendent is engaged in a struggle for power, publicity, an information network, and control linkages--all of which seem to be more rapidly available to him through innovation, or

d. the new superintendent lacks the power to be entrenched, which would imply a tendency to avoid, squash, or impede the suggestion or proposal of threatening or value-displacing innovations; and the new superintendent is not threatened by what threatens the system's veterans, and consequently is more likely to innovate, or

e. the new superintendent's hypothetical frustration at the entrenched bureaucracy (since he typically has little appointive power) leads to programmatic innovation, at least in part for its possibilities of "free appointments," or

f. the most innovative superintendents were hired in 1969 and 1970 (and the second discretely innovative group was hired in or after 1962); historical trends in the preferences of school boards' search groups, and in the people just arrived on the eligible job market, have resulted in the systematic variation of innovation by year of leadership hiring in some districts, or

g. superintendents interested in innovation typically make their mark quickly, wear out their welcome and their political resources, and move on, thereby contributing to high turnover rates and relatively recent new superintendent appointments in places where innovations are initiated, or

h. school superintendents are rapidly "turned over" or worn out by the political environments (or perhaps by the demands of school boards) which are the most innovative and challenging, thereby contributing to high turnover rates and relatively recent new superintendent appointments.

V. Submitting innovative proposals depends positively on whether the school board is elected, rather than appointed, because

a. elected boards, when combined with a conflictful political culture and a high saliency for schooling, seek innovations which both defuse and diffuse demands and conflicts, or

b. appointed boards are not educationally oriented--they serve the mayor or the party hierarchy or anti-tax interests, or

c. elected boards seek innovations to build their public images and enhance their chances for re-election.

VI. Submitting innovative proposals depends positively on whether the school system is fiscally independent of the municipal government or not, because

a. dependent systems, embedded in municipal budgetary politics, share power with the mayor and with local political interest groups, may have had problems with routine budgetary approvals when taxes are needed elsewhere, and therefore may lack the political power and discretion to stimulate and press for innovation, or

b. school systems which have historically lacked the power to change programs substantially (and fiscally dependent districts may be hypothesized to lack such power) probably continue to fail to change even with federal assistance, or

c. fiscally independent districts, because they experience the trade-offs and complexity of revenue-raising and budgeting, seek problem-solving devices more actively than do dependent districts.

VII. At the same time, submitting innovative proposals does *not* depend on the proportion of students in the school district who are poor, because

a. innovation is the *political* output of a public *organization*, and a decision cannot simply stem from an unarticulated socio-economic condition (and the political-organizational effects of community poverty are very indirect and complex), or

b. wealth is highly relevant to the *implementation* of innovations, but not to other components of the innovation processes (for example, the search, analysis, project formulation, and political approval mechanisms).

Other hypotheses which combine those above may be appropriate if an interaction between or among independent variables is associated with Section 306 application behaviors; this possibility will be discussed after some results are presented.

Is there any way to separate competing possible causes for a hypothesized link between project initiation and one of the independent variables so that they may be tested against each other? Without clear arguments that the measured independent variables represent one "cause" of innovation rather than another, a strong finding of association can help us prepare for the collection of more data--but cannot itself untangle the many possible explanations of a relationship. Our model will be useful to the extent that we can reject hypotheses as not supported by the data, or we can accept a whole group of hypotheses whose disagreements must be settled through further work.

BIVARIATE RELATIONSHIPS

Some of our hypotheses receive support from a brief examination of the probability of a school district's having submitted an innovative proposal, given the knowledge of its status on one of the six measured indicators. If we look at what proportion of school districts "innovated" for two or more categories of enrollment, cityness, superintendent's tenure, board selection, fiscal dependence, and poverty we may review the bivariate relationship of initiation with each of the other variables. Table 3 displays a tabulation of the levels of initiation behavior for each independent variable; for the whole sample, 43.3 percent of the 1243 districts submitted Section 306 applications. (For those 840 districts in which superintendency data was available, 50.4 percent of the districts submitted applications.) But two-way pictures of the innovation variable's

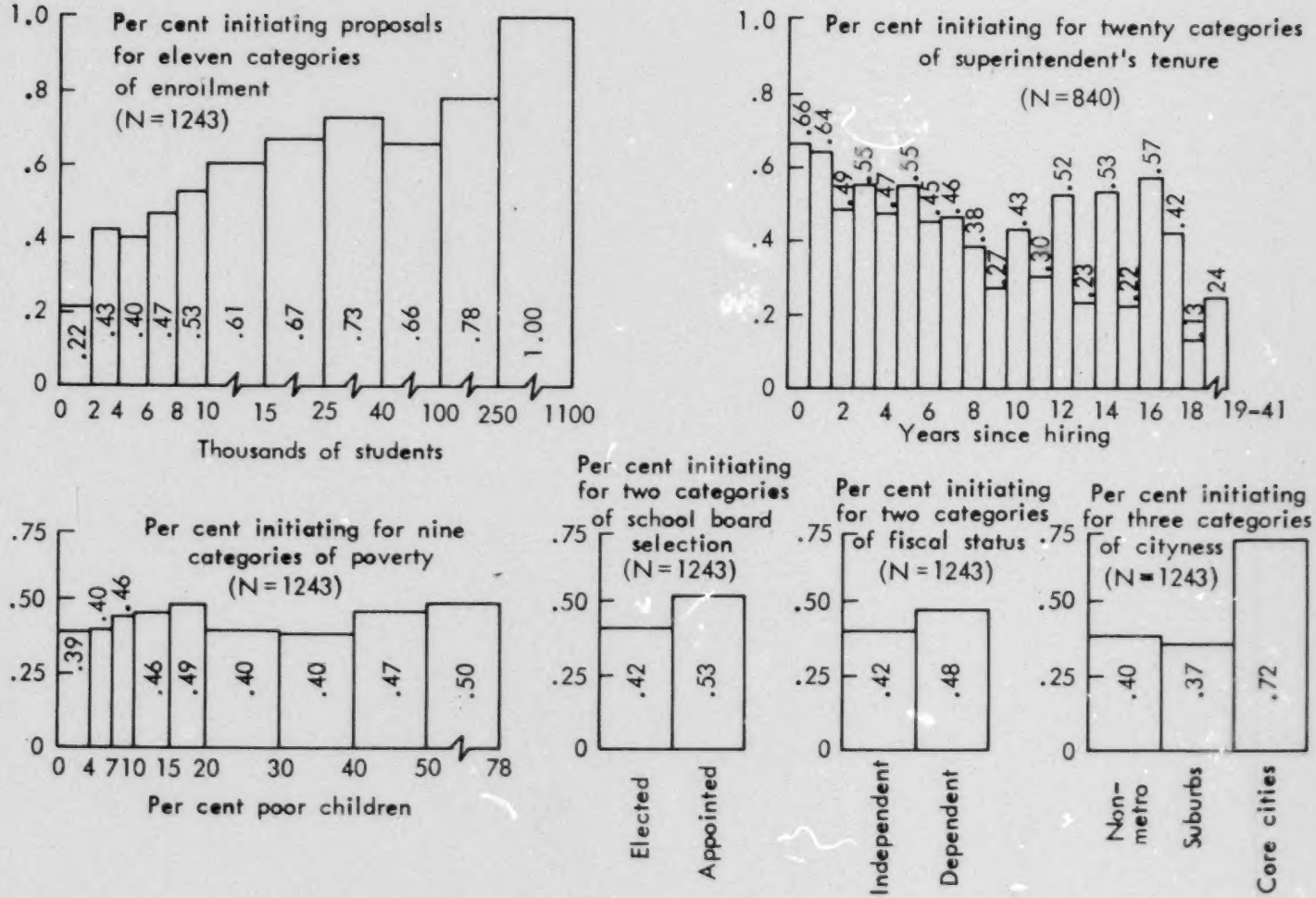

Table 3 —Bivariate relationships

relationship with the independent variables are simply not very useful for critically sorting and evaluating our collection of hypotheses.

MULTIVARIATE RELATIONSHIPS: METHOD OF ESTIMATION

Since our problem is to compare competing explanations for differences between school districts, a method of analysis which attacks several variables at once--and evaluates the predictive power of each--is required. We need to know, *given* a specified level or kind of cityness, superintendent's tenure, board selection, fiscal dependence, and poverty, whether a school system's enrollment enables us to predict its innovation behavior.

The ordinary least squares (O.L.S.) regression analysis model is not completely appropriate to this task. Our knowledge of initiation behavior is either-or: each school district submitted an application, or it did not. Therefore we have little reason to believe that the unobserved error term in the innovation observations has an expected value of zero, because there is no sensible interpretation of possible true values of innovativeness which are "less innovative" than our observation of no innovation, or "more innovative" than our observation of innovation. One possible excuse for our problem is the explanation that there is a "true" scale of innovative decision-making, but that due to measurement errors our observations are blind to all but two spots on it: we simply cannot resolve more finely than between a "yes" or "no" measurement. Unfortunately, our knowledge of school organizations does not give us much reason to believe the underlying scale story; we only believe that initiating districts differ somehow from non-innovative ones.

But if the causes of program initiation behave as if they created cumulative increases in the probability that a district will decide for or against the proposed innovation, and a threshold exists above which the accumulated probabilities result in the decision to submit a proposal (and below which they are likely to result in a decision or non-decision not to submit a proposal), then the conditions for estimation using the probit model are met.

And if the causes of initiation behave so as jointly to maximize the difference between innovative and non-innovative districts on some unknown linear function of the causal variables, then an estimate of the discriminant function which best separates the two classes or categories of school districts, applicants and non-applicants, is possible. (The theorems which define discriminant analysis are actually a special case of the O.L.S. regression analysis equations--for the either-or variable case, discriminant equations result from a simple arithmetic transformation of O.L.S. results. Consequently, they share most of the defects of regression for the current problem.)

So we have three statistical techniques, each of which can mechanically manipulate our data, but none of which is clearly meshed with our analytical problem. We cannot be sure of using the best, unbiased estimator for the relationships between innovation and other variables. We may, however, combine all three techniques with some common-sense graphical analysis to locate and explore some interesting relationships in the data. We are aware that the usual and correct interpretation of estimation results is not appropriate here. And we may only hope for the cross-validation of our several research methods. If this makes us more wary of our results, so much the better: like our verbal causal model, we use statistical estimates to explore our data, not data to verify our estimates.

MULTIVARIATE RELATIONSHIPS: PRESENTATION OF RESULTS

The estimation of coefficients for a multivariate O.L.S. regression model can begin to tell us the extent and size of the relationships which may influence the submission of innovative proposals. To include the effect of superintendent's tenure, we will initially consider only the 840 districts for which this information was available.

Submitting an innovative proposal =

$$.5396 + \underset{(.0003)}{.0006} \times \text{Enrollment} + \underset{(.0490)}{.2070} \times \text{Central City}$$

$$- .0733 \underset{(.0413)}{\times} \text{Suburb} + .0049 \underset{(.0379)}{\times} \text{Fiscal Status}$$

$$+ .0227 \underset{(.0526)}{\times} \text{Board Selection} - .0968 \underset{(.1743)}{\times} \text{Poverty}$$

$$- .0146 \underset{(.0026)}{\times} \text{Superintendent's Tenure}$$

(Standard errors in parentheses.)

$N = 840$

$R^2 = .095$

$F_{7,832} = 12.4 \ (p < .001)$

Note: the units for all results in this essay are as follows:

1. Dependent variable coded 1 for proposal submitted; 0 otherwise.
2. Enrollment multiplied by .001.
3. Central City coded 1; 0 otherwise.
4. Suburb coded 1 for non-core, metropolitan area; 0 otherwise.
5. Fiscal Status coded 0 for independent; 1 for dependent.
6. Board Selection coded 0 for elected; 1 for appointed.
7. Poverty expressed as a proportion from 0 to .7222.
8. Superintendent's Tenure in years.

This multivariate fit yields estimated coefficients which are approximately double their standard errors for all variables except fiscal status, board selection, and poverty. The fiscal status and board selection coefficients are very small and positive (which indicates that initiation rises with fiscal *dependence* and with the *appointment* of board members), which is not the predicted sign. The hypotheses on poverty--that community wealth does not affect the genesis of innovative proposals--can be compared with the finding that for an absolute increase in a district's proportion of poor children of 10 percent, the estimated measure of initiation falls somewhat less than .01 on our measured zero to one scale. Poverty's effects are small and diffuse (the coefficient's standard error is quite large, and therefore the estimated coefficient is not significantly different from zero), and even large shifts in community wealth should not lead us to expect important shifts in our predictions.

The estimated effect of enrollment, while quite stable, is small: an enrollment increase of 100,000 students leads to an estimated initiation gain of just .06 on the scale. Central cities have higher estimated scores by .2 compared to non-metropolitan districts, and suburbs are .07 lower than non-metropolitan districts. An increase of ten years in the time a superintendent has been in his job results in a fall in proposal-submitting of .15 on the zero-one scale, a powerful contribution to the explanation of program innovation behaviors. Each of these results, of course, expresses an independent variable's power to change the predicted initiation decision when the effect of variation in each of the other independent variables is statistically controlled. The most stable fits--enrollment, cityness, superintendency--give support to some of the hypotheses stated earlier, but better approximations of a predictive equation can be sought.

Our inspection of the bivariate plots (Table 3) for the three variables which are not expressed as binary "dummies," enrollment, poverty, and tenure, can suggest some transformations of those variables to fit more accurately (and, perhaps, suggestively) the likelihood of submitting an innovative proposal. And by more precisely matching the shape of the distributions of dependent and independent variables, the patterns of residuals can be expected to be more easily observed. The most useful transformations for these variables appear to be bending curves (such as the logarithmic curve) for enrollment and poverty, and non-monotonic specifications (such as a series of dummy variables representing scaled sections of a variable) for poverty and superintendent's tenure. Using Tukey's suggestions for removing bends from data, the best simple transformations for the data were found. Table 4 presents a comparison of equations which alternatively fit the best transformation of enrollment, superintendent's tenure, and poverty, while keeping the rest of the equation the same as our first fitted model. A useful tool to compare dissimilar measures such as enrollment and the logarithm

Table 4

REGRESSION COEFFICIENTS AND (t-RATIOS) FOR REGRESSIONS ON 'SUBMITTING INNOVATIVE PROPOSALS' OF VARIOUS COMBINATIONS OF VARIABLES, COMPUTED FOR 840 FULL-INFORMATION OBSERVATIONS

	Original Specification (page 23)	Transformation: ln (Enrollment)	Transformation: Tenure Dummies	Transformation: Poverty Dummy
Constant	.540	-.379	.312	.530
Enrollment	.0006 (1.87)	.129 (8.22)	.0005 (1.66)	.0006 (1.92)
Central City	.207 (4.22)	-.057 (-1.00)	.212 (4.34)	.207 (4.26)
Suburb	-.073 (-1.78)	-.162 (-3.92)	-.077 (-1.88)	-.078 (-2.05)
Poverty	-.097 (-.56)	-.150 (-.89)	-.099 (-.57)	-.079 (-1.76)
Fiscal Status	.005 (.13)	-.046 (-1.23)	.003 (.08)	.006 (.16)
Board Selection	.023 (.43)	-.028 (-.55)	.026 (.50)	.031 (.60)
Superintendent's Tenure	-.015 (-5.58)	-.014 (-5.53)	.280 .137 (5.95) (3.33)	-.014 (-5.50)
R^2	.095	.159	.099	.098
F	12.4	22.5	11.4	12.9
Constraints, Degrees of Freedom	7,832	7,832	8,831	7,832

NOTE: the dummy variables are constructed as follows:

1. Superintendent's Tenure dummies for zero to one years (coded 1, otherwise 0) and for two to eight years (coded 1, otherwise 0).
2. Poverty dummy coded 1 for districts with from 20 to 40 percent poor children, otherwise 0.

of enrollment (since we cannot expect the coefficients to be directly comparable) is the ratio of the estimated coefficient to its standard error, the t-ratio. This can tell us which data transformation is more stably related to initiation, though it does not determine which is a "better" (which might mean bigger and more explanatory) predictor.

The transformation of enrollment into its natural logarithm greatly improves the fit of school district size to the submission of proposals. (Reciprocal and quadratic transformations were tried, but proved to be less effective.) Since school districts are very diverse in their size, we are simply saying that the difference of enrollment between 50,000 and 100,000 has more effect on school organization behavior than does the difference of enrollment between 500,000 and 550,000. With increasing size, size itself exhibits a decreasing effect--but for districts as large as New York City (1,123,000) or Los Angeles (733,000), the cumulative effect of the logarithm of enrollment is still large. The literal interpretation of the regression results for the transformed enrollment variable is this: each time the enrollment of a sample district is tripled (actually, when it is multiplied by 2.718), its predicted innovation-decision score increases by .13 on the zero-one scale. For the districts in our sample, there are about seven such triplings between the smallest and the largest districts. The increase in expected initiation is constant for each multiplication by 2.718--but the absolute change in size required to raise the estimate is obviously much greater among large districts than among small ones.

The transformation of the superintendent's tenure measure into two dummy variables is based on an inspection of the bivariate relation of tenure and innovation (Table 3 above). Superintendents of zero or one year's experience in a district appear to be more inclined to submit a Section 306 application than do those of two to eight years' tenure; superintendents who are even more senior are even less likely to innovate through Title III. (A difference of means F-test confirms the obvious visual fact that the three groups differ with respect to initiation.) The regression results show

that the dummy variable coefficients for the two tenure groups were large (.28 and .14 on a zero-one scale) and quite stable. The dummy variable fit does not add much to the amount of variance explained with untransformed data (the multivariate R^2 rises hardly at all, from .095 to .099), but the dummy fit captures the effect of superintendent's tenure and is preferable for the estimation of equations which include the missing data points.

The interpretation of possible fits between community poverty and submitting innovative proposals is difficult; we can extract barely stable coefficients for a dummy variable fit, but that specification does not relate conceptually to the poverty hypotheses--that is, no fit tells us that poverty steadily and significantly increases, decreases, or leaves unchanged the expected level of innovation. And linear, reciprocal, logarithmic, and quadratic transformations do not reveal a significant, stable monotonic effect of poverty. This confims the hypotheses which claim that we may expect the poverty scale to have no influence on the generation of innovative proposals. And since there is a very great range of community poverty in our sample (from none to 77.4 percent of the children in the sample districts were poor, with a mean level of 15.0 percent and a large standard deviation, 12.4), the absence of a community wealth effect seems convincing. A dummy variable created to measure the effect of a district's having from 20 to 40 percent poor children is close to attaining significance, and its coefficient (-.079) is small but not trivial. Perhaps there is a small negative effect of poverty on innovation decisions in districts which have suffered difficult problems in integrating a substantial (but not a majority) proportion of poor, lower-class or black school children into the district's schools. There may be a large group of such districts in the 20 to 40 percent poor category. But without evidence which taps a public opinion, electoral, or administrative *link* between community wealth and innovation policy, empirical support for the inclusion of poverty in a predictive model of initiation does not exist, and the hypotheses which deny a

monotonically negative effect of poverty on initiation are supported. We should also remember that our bivariate plot showed that most groups of districts have *about the same* level of innovation, with respect to poverty.

Combining what we can infer from the four equations discussed so far, we may examine a model in which innovation decisions are predicted by three indicators: the natural logarithm of a district's enrollment, whether the district is metropolitan but not a core city, and an indicator of whether the district's superintendent was hired within about a year, up to eight years previously, or longer ago than eight years. Enrollment is best expressed as a logarithmic or decreasing-growth scale when this is done, the transformed enrollment variable captures most of the power of the central city indicator (since central cities are predictably large) but leaves a powerful effect to be explained by the non-core city, metropolitan variable. The effect of superintendent's tenure is quite fully captured by the two dummy variables. No fits for poverty are both meaningful and statistically significant, and the effects of fiscal dependence and appointed school boards are trivial. A simplified equation can now be estimated:

Submitting an innovative proposal =

$$-.591 + \underset{(.012)}{.114} \times \ln(\text{Enrollment}) - \underset{(.034)}{.134} \times \text{Suburb}$$

$$+ \underset{(.045)}{.259} \times \text{Tenture 0 or 1} + \underset{(.039)}{.134} \times \text{Tenure 2 to 8}$$

$N = 840$

$R^2 = .158$

$F_{4,835} = 39.1 \ (p < .001)$.

In seeking to guess the likelihood of innovation proposals by school districts, we now estimate that for our arbitrary innovation decision scale, each multiplication of enrollment by 2.7 increases the guessed innovativeness by about .114. Concurrently, non-core metropolitan districts are estimated to be .134 lower on initiation than

other similar districts, and a district with a superintendent hired less than nine years previously should be higher by at least .134 compared to other districts--and higher by an additional increment of .126 if its superintendent has tenure of a year or less.

While a large variety of quite complex models have been tested--including many possible interactions among variables--none has improved markedly on this simple additive combination of three effects on initiation. The possibility of generating incorrect estimates by improperly including in the model some school districts which could be "outliers" (that is, structurally different by evidence of their especially high or low scores on the variables poverty, tenure, and enrollment) also failed to be confirmed. But there remain important questions about the multivariate model to be answered:

1. Can we learn what the shape of the estimated fit means--that is, whether the coefficients really represent a verifiable phenomenon among and between collections of similar districts?
2. Does the model hold up for the full sample of 1243 districts--not just the arbitrarily chosen 840 districts for which full information is present?
3. Are the predictions of the model sensible and usable?
4. Are the previously noted incorrect assumptions of O.L.S. regression for the analysis of dichotomous measures (such as our innovation decision data) responsible for the observed coefficients and explained variance?
5. Can the residuals (the difference between the predicted innovation levels from our simple model and the actual, observed initiation levels) add any substance to our notions about the causes of new programs?

A GRAPHICAL VERIFICATION OF THE SIMPLE MODEL

Despite the significance levels of the coefficients obtained above, the simplified model may not seem thoroughly convincing on its face. After all, we are working with transformed data (not natural units), a somewhat arbitrary sample of complete information districts, a dependent variable whose numeric values (zero or one) are difficult to estimate--or to reify, and a relatively unconvincing

explained variance proportion of about 16 percent (R^2 = .158). A scatter plot of some of our observations cannot help us, primarily because of the last two issues mentioned.

If we summarize the data we have collected, by grouping several observations on school district behavior together, we may inspect a more manageable number of points on a graph and we may look for the trends which our regression results tell us to expect. For example, if we formed a group from, say, the first twenty school districts in our sample, we could calculate several summary measures of their behaviors:

- -the proportion of the districts that submitted Section 306 grant applications,
- -the average (mean) district enrollment for the group,
- -the number of newly hired, somewhat experienced, and very experienced superintendents employed by the group of districts, and
- -the number of non-core, metropolitan districts in the group.

Furthermore, to insure that some of our new summary (that is, grouped-together) information measurements come from (for example) very small and very large districts, we may create groups on the basis of the level of enrollment, tenure, and cityness of the individual district observations. By grouping with respect to the independent variables, we maximize the variance *between* groups for those variables while suppressing (by ignoring, perhaps randomizing, and "washing out") the variance between groups for all other variables. Statistically, we are highlighting the effects of enrollment, cityness, and tenure so that we may inspect and judge them; there is no reason to expect the shape of the relationship between dependent and independent variables to be biased unless important variables which are systematically related to the grouping rule (that is, to one of the included variables) are deleted.[15] From the correlation matrix of independent variables (Table 2b) we have no reason to expect this problem.

Diagrams 1 through 3 show the impact of enrollment, tenure, and city-ness on initiation for groups of school districts (the group sizes are arbitrary, because groups were formed to provide reasonable numbers of districts in each group). Group boundaries were identical to the categories already used for superintendent's tenure (three groups) and non-core, metropolitan districts (two groups); for enrollment, twelve groups were created.* Consider an example: fewer than one-fifth (17.4 percent) of the districts with superintendents hired nine or more years earlier and with enrollments of less than 993 submitted Section 306 applications, while almost nine-tenths (87.1 percent) of the districts with newly hired superintendents and with enrollments of more than 44,355 submitted applications.

Diagram 1, which plots 36 superintendent and enrollment groups against their innovation decisions, shows that a very wide range of variation in innovation--from groups in which 15 percent of districts submitted innovative proposals to groups in which about 85 percent of the districts submitted proposals--is explained quite well by enrollment and superintendent's tenure. A strong upward slope for enrollment is clear across all superintendent categories; a consistent separation among superintendent categories exists for almost all levels of enrollment. If this heuristic graphical presentation of two possible influences on initiation tells us anything, it is that enrollment and superintendent's tenure are powerful explanations of aggregate movements in submitting innovative proposals. Diagrams 2 and 3 dichotomize the 840 observations between the non-core, metropolitan districts (N = 414) and other districts (N = 426).** Both diagrams show the expected upward trend in levels of initiation for increasing enrollments. The amount of separation among superintendent groups is much more consistent for the non-core, metropolitan

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*In the total range of the logarithm of enrollment from 5.71 to 13.93, boundaries of 6.9, 7.6, 8.0, 8.25, 8.5, 8.8, 9.2, 9.5, 9.8, 10.1, and 10.7 were used.

**Mean levels of enrollment have been recomputed for each resulting group of school districts.

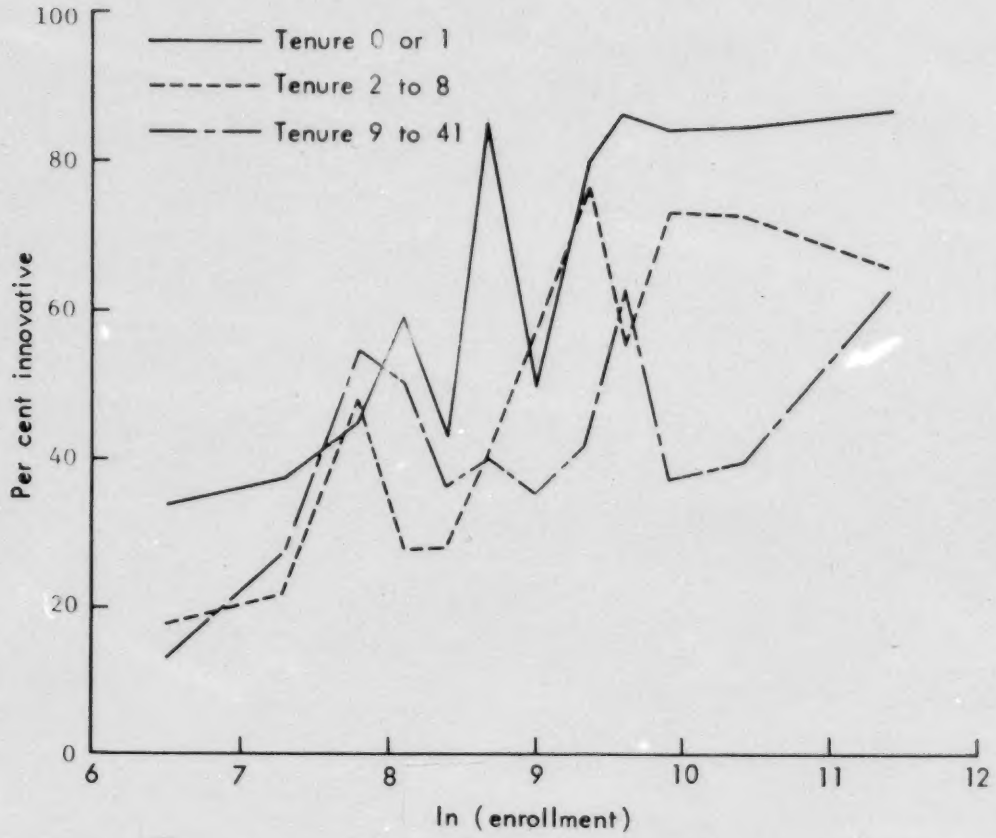

Fig. 1—Plot of per cent submitting innovative proposals for 36 grouped, summary data points (grouped by enrollment and superintendent's tenure)

840 full-information school districts

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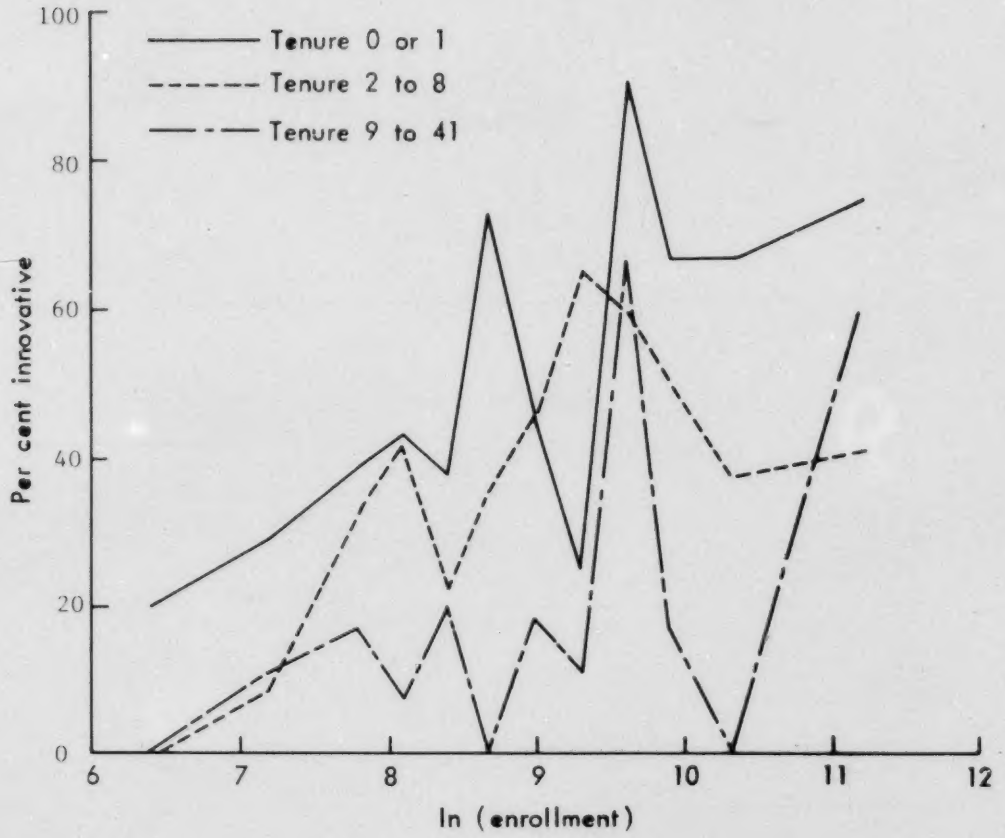

Fig. 2—Plot of per cent submitting innovative proposals for 36 grouped, summary data points (grouped by enrollment, superintendent's tenure, and cityness)

414 non-core-city, metropolitan school districts

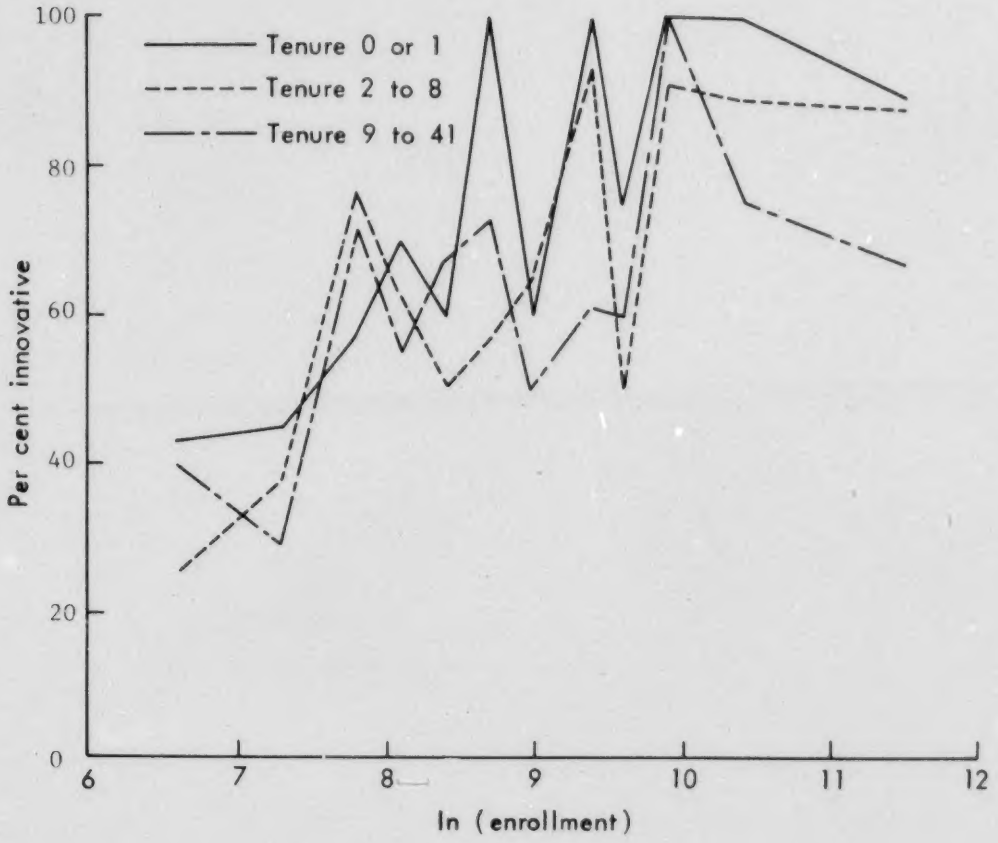

Fig. 3—Plot of per cent submitting innovative proposals for 36 grouped, summary data points (grouped by enrollment, superintendent's tenure, and cityness)

426 core city and non-metropolitan school districts

districts than for other districts. Perhaps this is due to the substantially higher mean levels of proposal-submitting for the central city and "other" districts, a phenomenon (possibly related to "topping out" in growth phenomena) which could mask the differences due to incentives not to innovate that would ordinarily be strong among very senior superintendents. Alternatively, perhaps the small number of districts in several groups could create a sampling error problem in Diagram 3. (The discussion of residuals below points out that high variation within the group of senior superintendents goes along with their generally low levels of initiation.) In general, the graphs show the extent and power of the phenomenon which our earlier regression presented more abstractly. The regression model presented above for our data on individual districts is essentially equivalent, and mathematically just as powerful a model of the innovation decision process, as the more striking and tangible diagrams for summarized, grouped data.*

AN EXTENSION OF THE MODEL TO A COMPLETE SAMPLE

The 840 school districts analyzed so far in our exploratory model-building enterprise have been an arbitrary subset of the carefully constructed sample of districts introduced early in this essay, for the simple reason that no information on superintendent's tenure was available for 403 of the sample districts.**

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*A demonstration of the amount and stability of fit between initiation and the three predictive variables for our grouped, summary data points is presented as two weighted regressions[16] in Appendix 2. These equations allow us to make *estimates* of the proportion of districts in each group which submit innovative proposals, and these estimates range from .118 to .916 for the 36 summary groups in Diagram 1--a substantial scope for three elementary influences on innovation.

**Nor was this missing data recoverable by estimation: a regression of all the other independent variables, used to predict superintendent's tenure, produced only 5 percent explained variation and small coefficients--so estimating the missing districts would simply amount to substituting the mean of the districts for the missing values.

But if there is no important (that is, structural) difference between the full-information and missing-information districts, we can get along without the missing data. The equation which we hope to support uses a three-category specification for superintendent's tenure, which is substantively the same as the two-category fit used previously. (By including three dummy variables, one for each category of tenure, instead of only including variables for two of the three categories, and assigning values of zero on all three dummies to each district for which we have no information, we constrain the intercept term to include the mean superintendent's tenure coefficient for all missing-information districts.) We may test the hypothesis that the effects of enrollment and cityness are the same for the full-information districts and the other districts: that the unmeasured effect of superintendent's tenure in the missing-information districts does not influence the explanatory effect of the other variables. If this hypothesis can be supported, then other multivariate inferences may be drawn from the full sample of 1243 districts.

The appropriate statistical test for the hypothesis that our model may be used as a single equation for the complete sample is basically a comparison of using one equation for all 1243 data points versus using two different equations for the sets of 840 *full-information* and 403 *other* data points. (This is a rather unusual statistical test; essentially, we hope to *accept* the null hypothesis that there is no difference between the subsamples.) We may now compare

Equation A for 1243 districts (the null hypothesis):

Submitting an innovative proposal =

a + b x ln (Enrollment) + c x Suburb
+ d x Tenure 0 or 1 + e x Tenure 2 to 8
+ f x Tenure 9 to 41,

to Equation B for 840 full-information districts:

Submitting an innovative proposal =

a + b x ln (Enrollment) + c x Suburb

+ d x Tenure 0 or 1 + e x Tenure 2 to 8,

and Equation C for 403 missing-information districts:

Submitting an innovative proposal =

a + b x ln (Enrollment) + c x Suburb.

Now we compare the sums of the squared residuals (SSR) for each equation, controlling for the degrees of freedom lost by using each variable several times, and compute the F-value:

$$F_{6,1237} = \frac{\frac{SSR_A - (SSR_B + SSR_C)}{6}}{\frac{SSR_B + SSR_C}{1243 - 17}} = .072.$$

For $F_{6,1237}$ and the 10 percent confidence region, the critical value which calls for rejecting our null hypothesis is 1.774. So even if we set a low-confidence (that is, *easy*) criterion for rejecting the null hypothesis that the full-information and missing-information districts are structurally *the same*, we cannot reject that hypothesis. We may conclude that there is no evidence of a structural difference between districts for which we lack superintendent data and full-information districts, and there is no reason to suspect different patterns of relationships between the independent variables and the expected level of innovation for the two subsamples.

Analysis of all independent variables in several multivariate fits (including fits which transformed independent variables and which used interactions among variables to estimate initiation) came to substantially the same conclusions for the complete sample as for the full-information sample. The coefficient for the measure of local poverty levels was larger and took a positive sign instead of its negative sign for the smaller sample, but the coefficient's standard error was of fairly large size, indicating considerable

instability. (Estimated equations repeating some of the exploratory results of Table 4 for the sample of 1243 districts are presented in Appendix 3.) Interactions between superintendent's tenure and enrollment, between fiscal dependence and school board selection, between poverty and enrollment, between poverty and cityness, between superintendent's tenure and school board selection, and between fiscal dependence and poverty were tried. None had both more importance than the separate effects of the variables, and a stable coefficient. The elimination of possible "outlier" districts of very high or low enrollment, tenure, or poverty had almost no impact on coefficient estimates. The estimates which best combine important effects on innovation decisions, for the complete sample of nationally representative districts and Section 306 applicant districts, are those of the simple three variable model.

Submitting an innovative proposal =

$$-.542 + \underset{(.010)}{.116} \times \ln(\text{Enrollment}) - \underset{(.027)}{.122} \times \text{Suburb} + \underset{(.040)}{.192} \times \text{Tenure 0 or 1} + \underset{(.033)}{.067} \times \text{Tenure 2 to 8} - \underset{(.040)}{.066} \times \text{Tenure 9 to 41}$$

$N = 1243$

$R^2 = .168$

$F_{5,1237} = 50.0$ $(p < .001)$.

The sizes of the coefficients in this estimate are very close to those in the model of 840 districts discussed previously. Increasing enrollment exerts a strong positive influence on initiation, but at a fairly rapidly declining rate. Non-core city, metropolitan districts are distinctly less likely to submit a proposal than are other districts which are similar to them in size of enrollment and in superintendent's tenure (and, of course, in community wealth). Also, because we have included an indicator of urbanness in the equation, we may be sure that the effect of enrollment is one of size, rather than of cityness.

There is a substantial decline in predicted initiation explained by a moderate or long tenure of a district's superintendent, across similar sorts of districts.

The range of predictions from our model provides a final gauge for the value of our estimates. By choosing some arbitrary levels of the three important independent variables, we can judge the sensitivity of the model to interesting combinations of shifts among types of school districts. Table 5 gives the predicted value of the dependent variable ($\hat{Y}_i$) on our zero-one innovation-decision scale for some arbitrarily selected combinations of enrollment, tenure, and cityness.

Table 5

INITIATION PREDICTION, ESTIMATED FROM 1243 DISTRICTS

Enrollment	Non-core, Metropolitan			Other		
	Tenure:			Tenure:		
	0-1	2-8	9-41	0-1	2-8	9-41
1,000	.330	.205	.072	.452	.327	.194
10,000	.596	.471	.338	.718	.593	.460
100,000	.863	.738	.605	.985	.860	.727

Two characteristics of the collection of numbers in Table 5 are striking: first, that there is a wide range of predictions made by our estimated model for proposal-submitting, and second, that quite large differences in the independent variables are required to bring about the variation in estimates. It is only in trying to explain a universe of phenomena as fragmented and dissimilar and independent as innovation decision-making in American schools that the level of sensitivity to change shown in Table 5 is acceptable. Yet that fragmentation, dissimilarity, and independence of process and outcome

is precisely what makes the decision to pursue innovation an intriguing modeling problem. Those traits mean as well that an explanation of initiation in public organizations is a powerful lever for our understanding of decentralized political outcomes, of trends in responsibilities and technologies accepted by administrative and service institutions, and of the problem-solving abilities of diverse organizations in highly varied environments.

PREDICTIONS AND ASSUMPTIONS: SENSIBLE AND USABLE?

The estimates from our simple model for Section 306 application behavior by school districts are not guesses as to whether each district did or did not submit an innovative proposal. They are simply numbers picked by a procedure designed to minimize the sum of squared errors (that is, the difference between the chosen numbers and the respective "real" values of zero or one), given certain prior information about the relationship that the dependent and independent variable measures exhibit in a collection of sample observations. We have used regression analysis to uncover those relationships, but the estimates which we have produced lack a substantive interpretation.

The best claim that can be made for the regression estimates is that they reflect the likelihood of submitting an application, given the post hoc datum that each district did or did not submit an application. But estimated values above one and below zero are then meaningless (all likelihoods lie in the range from zero to one), and such values do result in our model. Regression is a valuable tool for the exploration of relationships in data, but its predictions are not intuitively sensible.

The usefulness of an exploratory regression equation is often measured by a goodness-of-fit criterion--generally the R^2 statistic, the proportion of total variance accounted for ("explained") by the fitted multivariate equation. Our estimated equation explains 16.8 percent of the variance in innovation behavior, a relatively poor showing. This low figure is suspicious if we recall the strong slopes and separations of Diagrams 1 through 3. The problem, of

course, is that very great accuracy (and not just a set of strong relationships) is required to drive the *predicted* values of a dichotomous dependent variable to zero or one, thereby gaining a high R^2 statistic.

However, if we take the results of the estimated regression equation as data in a decision process which seeks to assign each school district's particular combination of enrollment, superintendent's tenure, and cityness to a "best guess" on whether that district submitted a Section 306 application, we may find our model to be more usable. Discriminant analysis is a technique designed to assign coefficients to independent variables in such a way that the resulting values of the discriminant function classify each observation into one of two or more categories. The guessed category is analogous to the likelihood prediction which results from O.L.S. regression analysis. In the terms of discriminant analysis, our problem is to choose the linear combination of enrollment, superintendent's tenure, and cityness which most accurately divides the sample school districts into "expected initiators" and "expected non-initiators." There is an easy transformation of O.L.S. regression coefficients into discriminant coefficients.[17] For our model of 1243 school districts, the Fisher fixed-form discriminant function is

Initiation discriminant =
.00038 x ln (Enrollment) - .00040 x Suburb
+ .00063 x Tenure 0 or 1 + .00022 x Tenure 2 to 8
- .00022 x Tenure 9 to 41.

The critical value for the function is .003242; districts whose discriminant values exceed the critical value are assigned to the group of probable proposal-submitting districts, and those districts whose values fall below the value are assigned to the group of districts not expected to submit innovation proposals.

For the 1243 sample school districts, the discriminant analysis version of our exploratory regression model correctly predicts 835, or 67.2 percent, of the observations. This finding is much more encouraging than that of the R^2 statistic. While discriminant *coefficients* lack a sensible interpretation, their substance comes from success at predictions of behavioral outcomes. The 67.2 percent success rate of our model may be compared with a 50 percent expected success rate for flipping a coin to guess at each district's category, and with a 56.7 percent success rate if we always guess that a district did not innovate (this "optimal information estimate" is purely a function of the arbitrary division of the sample between 538 initiating and 705 non-initiating districts). The discriminant predictions are a measure of the possible success of the modeling process, and they indicate that our hypotheses actually help us know what happens in individual, real school districts.

Unfortunately, despite the applicability of discriminant analysis's goal of classifying observations into discrete categories to our data base, discriminant analysis shares mathematical limitations with O.L.S. regression techniques. The assumption of a constant error variance is not met for problems in which the dependent variable is dichotomous. The likelihood of systematic error in the dependent variable is likewise great (that is, the expected value of the error term is not zero). In other words, the regression and discriminant theorems are not appropriate for an accurate, confirmatory analysis of our innovation data.

Another set of theorems may be more appropriate for our data. Probit analysis is based on a model of dichotomous observed effects which are assumed to depend on whether a particular specimen's characteristics combine to drive it past some threshold level of an underlying scale of the dependent variable. The probit function is S-shaped: steeply sloping up in the middle and flat at the ends, it implies that low levels of the independent variables (a sort of "treatment" to be slowly applied to the specimens being studied) have little impact on the dependent variable while middle levels

have a great power to push past the threshold, and high levels are again small in importance. Probit estimation results in the selection of a function whose values, if less than zero, predict that initiation did not occur, and if greater than zero, that it did. A probit estimate may be properly transformed into a probability that an observation should be guessed to be innovative or not. The maximum likelihood estimates and standard errors of the probit analysis which is analogous to our model follow:

Probit estimate for initiation =

$$-3.054 + \underset{(.031)}{.341} \times \ln(\text{Enrollment}) - \underset{(.081)}{.347} \times \text{Suburb}$$
$$+ \underset{(.105)}{.398} \times \text{Tenure 0 or 1} + \underset{(.103)}{.211} \times \text{Tenure 2 to 8}$$
$$- \underset{(.119)}{.193} \times \text{Tenure 9 to 41.}$$

The probit model correctly predicts 845, or 68.0 percent, of the 1243 observations. This result closely follows our regression and discriminant findings, and while our exploratory analysis was not carried out using the probit model, we may treat this result as a partial confirmation of our regression findings. Because an alternative way of viewing our modeling problem, such as probit analysis, yields similar results and levels of statistical significance, our confidence in earlier findings should be increased.*

ANALYSIS OF RESIDUALS

The careful and repeated application of exploratory fitting techniques to a body of data can be viewed as a way of dividing what

*Another probabilistic maximum-likelihood approach to curve-fitting for dichotomous dependent variables is given in Marc Nerlove and S. James Press, *Univariate and Multivariate Log-Linear and Logistic Models*, (R-1306). This technique correctly predicted 822, or 66.1 percent, of the innovation decisions. The ratios of coefficients to standard errors were essentially mirrors of the O.L.S. and probit estimates.

we know about each observation into two parts: a *fitted description* and a *residual*. So far we have concentrated on the fit of independent variables to school district innovation decisions, but the analysis of residuals is also a rich source of knowledge about innovation. John Tukey portrays the division of analysis into fit and residual this way: "Clearing away big--or obvious--effects so as to see smaller--or camouflaged--ones is a major task of exploratory data analysis...Residuals have had the fit subtracted so we can see what remains."[18] When we speak of analyzing residuals, we refer to examining the difference between the observed innovation decision for each school district and the regression-predicted score for each district.

Two methods of residual analysis are useful for our data. First, we can compare the varying levels of residuals to particular levels of the independent variables. For example, we look for any pattern in the general trend of residuals for, say, very rich and very poor school districts. Second, we can look at some particular school districts that have intriguingly high or low residuals. For instance, we might simply think about the size of the residual for the St. Louis, Missouri, school district.

Grouping school districts by the tenure of their superintendents, we may compute the mean residual and the standard deviation for each group. Essentially, this is a summary picture of the association of tenure and innovation which is *not* captured by our multivariate model. A bar graph presenting these mean residuals is given in Diagram 4. Two superintendent's tenure groups have extreme residuals and relatively low standard deviations: those for twelve years (whose superintendents were hired in 1958) and for 21 to 41 years (hired before 1950). Our hypotheses about the effects of leadership's entrenchment on innovation decisions may explain the negative residual for the latter group. Perhaps the positive residual for the twelve-year veterans demands an historical explanation: 1958 was the year after Sputnik and the year of the National Defense Education Act's passage by Congress, and it seems quite possible that superintendents who were on the job market in that red-letter year for education would

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Note: These residuals, and those shown in Figs. 5 through 9, result from the equation on page 38; N=1243.

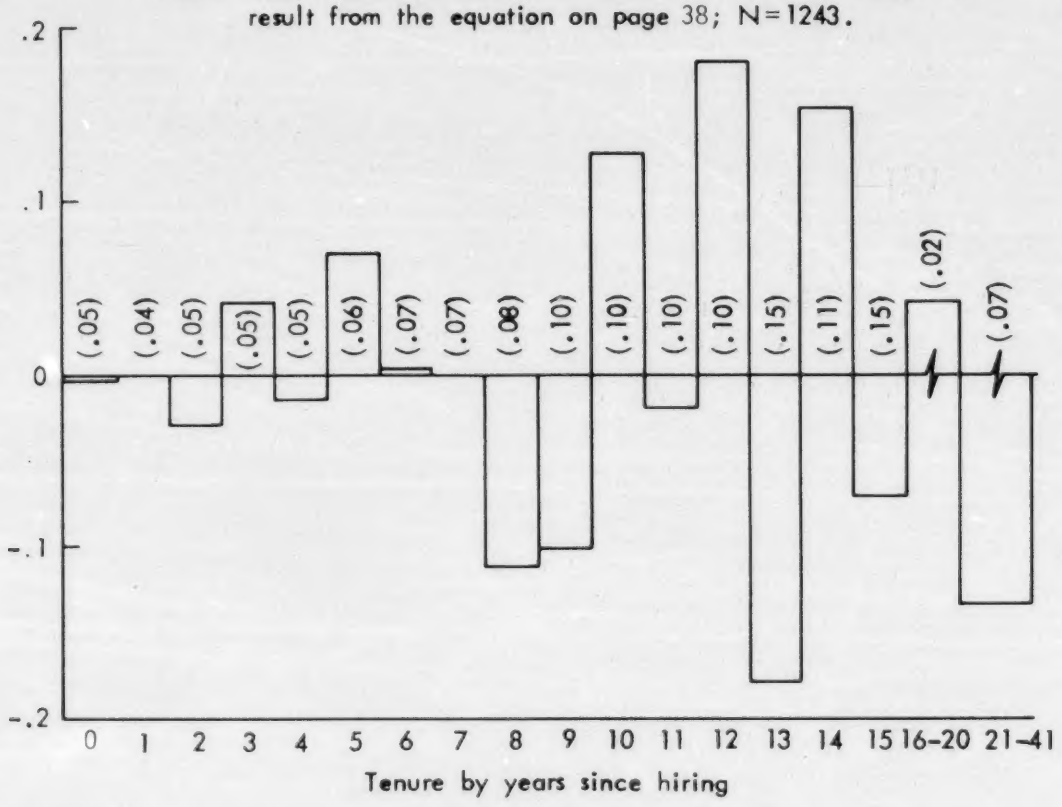

Fig. 4—Average residuals, grouped by superintendent's tenure

(Corresponding standard deviations in parentheses)

be inclined, even years later, to be more concerned about progressivism and change than superintendents who are similarly situated but who were insulated from the atmosphere of 1958. If we accept this historical explanation based on the assumed responsiveness of job-seeking administrators to the economic and social tenor of a vital period in their professional lives, then other grouped residuals may be explained similarly. The positive residual of 1965's superintendents could reflect the Johnson electoral landslide (in part a social-issue referendum), or the passage in March 1965 of the precedent-breaking Elementary and Secondary Education Act. The negative residuals of 1961 and 1962 might have some tie to the recession of 1960-61, perhaps through the reaction of property-tax-bearing citizens to continued pressures for more school expansion, as baby-boom students entered the high schools. The residuals of 1956 (positive) and 1957 (negative) are harder to tie to national preoccupations; indeed, the large year-to-year shifts of the direction of residuals for years before 1962 have a seemingly unpredictable character, despite the low mean level of initiation for the pre-1962 superintendents. One hypothesis states that a new superintendent's young staff seeks innovation to show fast results of his leadership; perhaps *without* the special incentives of freshness and inexperience, innovation's support from the headquarters staff is simply highly variable. (Small-sample bias could accentuate the observed variation, as well.) In general, the relatively high standard deviations of most tenure groups show that most of tenure's impact on innovation decisions is captured by the multivariate fit.

When residuals are grouped by enrollment, a less erratic pattern emerges. (Mean residuals for enrollment groups are presented in Diagram 5.) Districts with enrollments from 10,000 to 30,000 have positive residuals; most groups of districts larger than 30,000 have negative residuals. After removing the logarithmically increasing curve of enrollment, we could surmise that there are small economies of scale beginning at an enrollment of 10,000, and diseconomies of scale beginning at 30,000. That is, in terms of

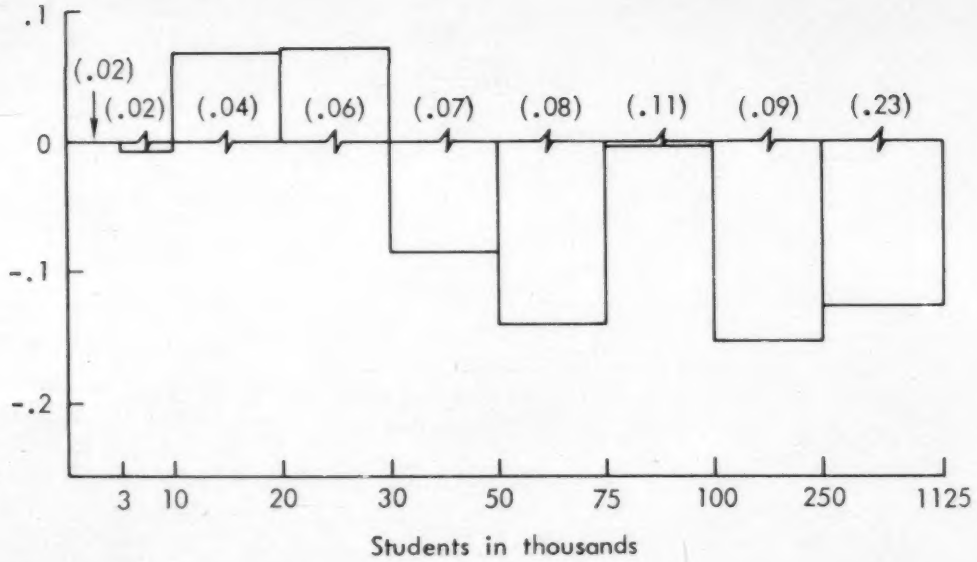

Fig. 5—Average residuals, grouped by enrollment

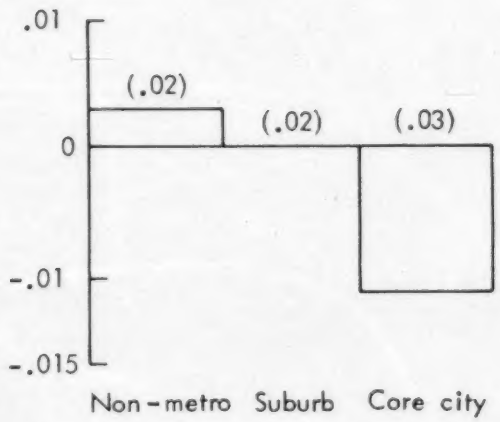

Fig. 6—Average residuals, grouped by cityness

our original hypothesis, the benefits of task complexity, professional diversity and reward structures, and administrative overhead are present in abundance once a district has more than 10,000 students; for extremely large organizations, however, decay factors such as narrowness, specialization, and Parkinsonian bureaucracy can lead to fewer new proposals than we would otherwise expect--given the overall trends in initiation with regard to enrollment. Of course, these dynamics are to be imagined to operate after the positive effects of increasing size have been removed. But the combination of a logarithmic fit for school district size and the pattern of residuals for enrollment tend to support our organization-size hypothesis for innovation decisions.

Comparing the residuals of school districts which are in central cities, non-central metropolitan areas, and non-metropolitan areas (presented in Diagram 6), we find that after removing the effects of the "suburban" dummy variable and the effects of enrollment, there is little to be accounted for by urbanness. The relatively high group standard deviations indicate that there is terrific variation within each category--that is, that school organizations differ greatly even when we focus on the problems of big central cities, or major suburbs, or small rural districts. While this variation adds nothing to our evidence on the hypothesized causes of proposal-submitting, it supports the view that trends in initiation decisions may be encouraged if we can discover the roots of differences among similarly situated public organizations.*

The residuals for school districts grouped according to local community poverty appear to take a "U" shape, shown in Diagram 9. Residuals are positive for most of the poorest and richest districts, and are strongly negative for districts with from 25 to 35 percent poor children. We do not know whether there is a *political* difference between districts with substantial, but not overwhelming, levels

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*A quick examination of our residuals for school districts which are fiscally independent or dependent, and for those with elected versus appointed school boards, tells a similar story: very small average residuals, and very high standard deviations. Diagrams 7 and 8 present these results.

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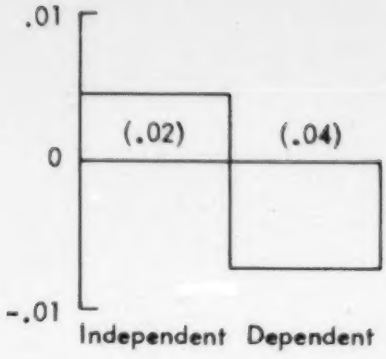

Fig. 7—Average residuals, grouped by fiscal status

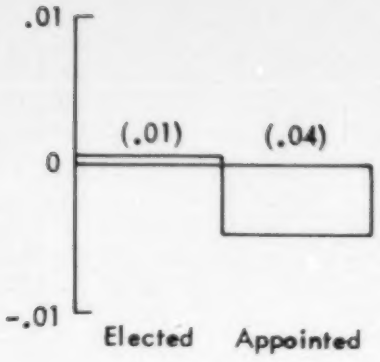

Fig. 8—Average residuals, grouped by board selection

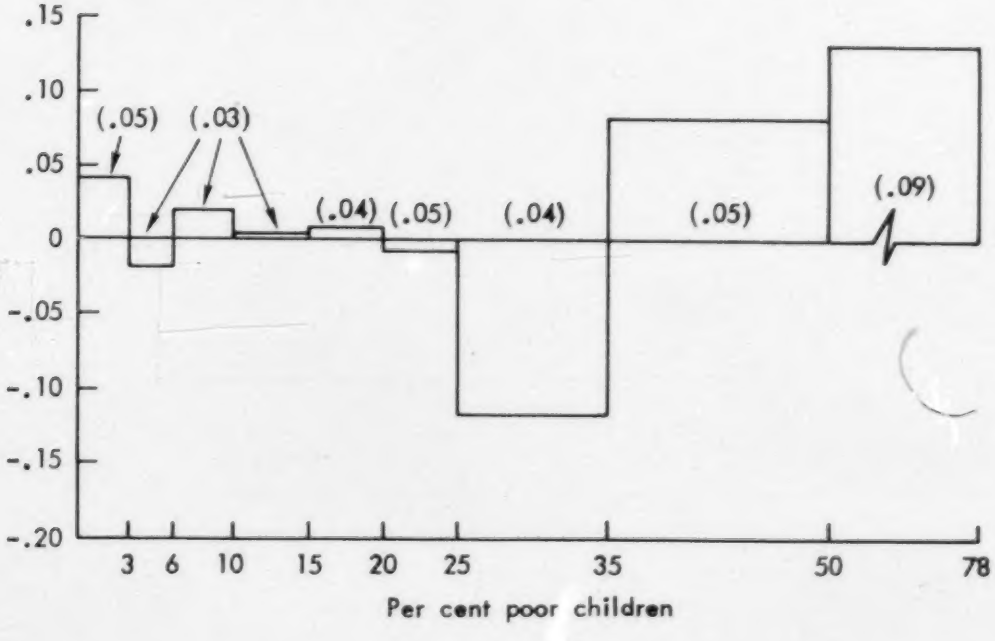

Fig. 9—Average residuals, grouped by poverty

of poverty and other districts. One speculation might be that the 25 to 35 percent poor districts are those most likely to have faced severe race and class integration conflicts in 1970; if middle class majorities in such districts were holding closely to existing programs and stable structures of authority, then local school organizations may have faced political difficulty in obtaining local consent for even federally funded innovations. But without data on political conflict, this is speculation. Most of the poverty groups had high standard deviations, indicating the great diversity of outcomes for innovation decisions. The 25 to 35 percent poor group are more stable, again suggesting that a political conflict dimension may underlie our economic data--since these poverty groups represent the fulcrum of domination of school populations by poor, as opposed to middle class, students (and their respective parents). In terms of the original hypotheses, the residuals indicate that the *school politics* aspects of poverty, rather than its *economic* or *interest group demand* aspects, may explain some relationships between innovation decisions and community poverty.

In summary, our analysis of residuals grouped by our independent variables has added some depth to our hypotheses on the positive effect of enrollment; has illuminated some historical bases of the effects of superintendent's tenure, and has supported an hypothesis on the impact of entrenched leadership; has raised some questions about the political correlates of moderate levels of community poverty; and has re-emphasized the analytic importance of variation among similar school districts with regard to innovative behaviors, suggesting the possibility of improving decentralized problem-solving by understanding the process of innovation decision-making.

An alternative way of looking at the array of residuals for the sample of school districts is simply to look at the largest residuals: the worst predictions of our simple model. If we consider only residuals greater than .8 and less than -.8, we may examine the 30 districts which acted as we would least expect a district to behave.

Wrongly Predicted Not to Submit an Innovative Proposal

Indian Oasis Schools, Sells, Arizona
Page Schools, Page, Arizona
Sacaton Schools, Sacaton, Arizona
East Side Schools #5, Menifee, Arkansas
Coachella Valley Union High School, Coachella, California
Winters Unified Schools, Winters, California
Woodlake High School, Woodlake, California
Marsing Schools, Marsing, Idaho
Porter County Schools, Valparaiso, Indiana
Paintsville Schools, Paintsville, Kentucky
Freetown-Lakeville Schools, East Freetown, Massachusetts
Holland Central Schools #1, Holland, New York
Bethel Schools, Tipp City, Ohio
Big Walnut Schools, Sunbury, Ohio
Columbus Grove Schools, Columbus Grove, Ohio
Bishop Schools, Lawton, Oklahoma
Drumright Schools #39, Drumright, Oklahoma
Kemmerer Schools #1, Kemmerer, Wyoming

Wrongly Predicted to Submit an Innovative Proposal

Birmingham City Schools, Birmingham, Alabama
Oakland City Schools, Oakland, California
San Diego City Schools, San Diego, California
Polk County Schools, Bartow, Florida
St. Louis City Schools, St. Louis, Missouri
Omaha Schools #1, Omaha, Nebraska
Mecklenburg County-Charlotte City Schools, Charlotte, North Carolina
Austin Schools, Austin, Texas
Dallas Schools, Dallas, Texas
Fort Worth Schools, Fort Worth, Texas
Houston Schools, Houston, Texas
San Antonio Schools, San Antonio, Texas

Of the 18 districts incorrectly predicted not to submit a proposal, all are small (just one, Lawton, Oklahoma, is in a core city--and it has an enrollment of 498) and eight are in western states. Administrative professionalism in the public schools has deep roots in the West; perhaps some small districts there behave as if they faced the task complexity and professional reward structures generally present in much larger districts. It would be very intriguing to know the sort of innovative proposals made by these high-residual

districts, and by the other small Section 306 applicant districts, but a meaningful analysis would depend on a comparison with *all* proposals submitted--something beyond the scope of this essay.

The twelve districts which our model incorrectly found to be likely to submit a proposal are all fairly large (all except one, Polk County Schools, are in central cities; Polk County's enrollment is 53,712, more than twice that of, say, New Haven). In addition, eight are in southern states--five are in Texas--and several have had well-publicized racial troubles. The political interpretation of this group's membership seems to revolve around severe community stresses which infect school systems and school decisions, while the school organizations are philosophically or politically disposed to deal with the stresses by maintaining existing programs and problem-solving techniques. (This interpretation is similar to our analysis of the stable negative residual for districts with 25 to 35 percent poor children.) This study has generally not sought to identify the impact of community political issues and political culture on school decision-making; these school districts provide some interesting material for speculation about that sort of impact. The linkage between local political culture and non-innovative behaviors may be made through the elected school boards in these cities, as originally hypothesized--since eleven of the twelve districts elect their school board members.*

The analysis of extraordinarily high and low residual school districts points up the remarkable variation in the sample: decentralized decision-making in highly diverse public organizations leads to some very unexpected outcomes. Two issues for further investigation have been raised--and must be deferred, for we lack the information to incorporate and test more hypotheses in our model. First, we found the possibility that some professionally-oriented small

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*Such a proportion is not too different from the proportion of elected boards in the whole sample; still, a linkage of community politics to school decisions through elected boards is not contradicted by the data.

school districts may be induced to innovate by ideas that suggest turning to the leadership of the national education hierarchy for assistance and funds. Clearly, a detailed examination of the proposals submitted by these districts could be very useful for our model. Second, the constraining influence of a conflictful local political culture on innovation decisions in large school organizations was suggested by the collection of unexpectedly un-innovative districts, all but one of which had elected school board members. Indicators sensitive to various kinds and intensities of political cleavages could be a useful addition to our model, provided we have a clear conception of the way local tensions are translated into the actions of public organizations.

THE INNOVATION DECISION PROCESS: CONCLUSIONS

The simple model developed in this essay, designed to predict the generation of innovative proposals by school districts, is a first step toward an empirical model of the translation of ideas into change in public organizations. The decentralized, independent, and fragmented nature of public decision-making for schools has allowed us to test, shape, and discuss the processes by which some organizations are able to adapt to the demands of their own controlling environments.

Public institutions have been closely dependent on the growth, acceptance, and development of liberal governmental theory in America; the steps by which liberal problem-solving ideas become policies within public organizations are the central elements of the adaptive innovation process. This is because the combination of searching behaviors, the analysis and formulation of possible new programs, and the schemes of political clearance and approval which are *prerequisite* to innovation are also the intellectual recommendations of rational liberalism. To the extent that large, complex and diverse organizations, not primarily in areas peripheral to the core cities, with newly installed leaderships are the most capable and the most inclined to innovate, then they can be predicted to press

the further development of liberal approaches to social change based on adaptive problem-solving.

The decentralized nature of American public organizations means that local decisions matter. This essay has been addressed to school organizations, but they do not monopolize the ability or the pressures to innovate.

> In hospitals, concern over costs and confusion over services and responsibilities are growing. Hospitals share with our school districts the possibilities for new, frustrated administrators without staffs, under pressure to show results; great variations in task complexity, professional diversity and the rewards of professionalism; and a myriad of links to city, state, and national governments. In addition, they must adapt to a variety of research orientations, constant competition for grants, and unique ways of seeking public and private recognition and support.
>
> Police departments frequently face corruption scandals and a deeply embedded public fear of crime instead of reading failures and student unrest. Yet the politics of appointing commissioners, the variation in the training and cosmopolitanism of police executives, the complexities of urbanness, and the modes of manipulating public information have a great deal in common with school systems' structures for change.
>
> Welfare officials try to invent strategies for job training, teaching the work ethic, and ending dependency--and all they have as supporting theory is a series of sociological fads. But their tools and constraints sound quite familiar to us: publicly acclaimed new programs, social worker professionalism, and the municipal budgeting process are only the most prominent of them.
>
> Housing agencies rarely deliver services directly to citizens; they do not contain street-level bureaucrats; and they primarily work with entrepreneurs, engineers, and financial experts. Their similarity to school organizations comes from their mixing of professions, their constant mediation among veto groups, and their dependence on the "needs" (that is, perceived important demands) and political orientations of their city environment.

The model of innovation decisions in school districts relies on variables which have apt analogues in other public organizations--

organizations in which innovation is the key to decentralized, adaptive, and insightful problem-solving. While our empirical research cannot be generalized to hospitals, the police, welfare bureaus, and housing agencies, it can suggest the tests which need to be made to confirm our claims about public organizations. The verbal model for new program initiation posed near the beginning of this essay has a concrete embodiment for each organization charged with the policy and administration of our political and civil institutions.

Given the findings presented in this essay, we now have the capacity to alter the verbal model of the innovation decision-making process for public school organizations. With each set of results obtained as we investigate innovation, our previous expectations are altered and we have a new set of expectations to guide us, and to be tested, in further research.

Decision outcome: submitting an innovative proposal = f {

The existence of sufficient and diverse professionalized executive headquarters personnel to pursue and develop innovative proposals;

The organizational environment and incentives for school system staff members to seek innovative solutions to current problems;

The presence of incentives for the system's executive actively to pursue changed policies, for organizational, psychological, informational, political, and historical reasons;

The presence or absence of an entrenched organizational leadership;

The presence of complex and demanding decision-making situations which promote the consideration of innovation;

The political links to the municipal environment which promote innovation processes by focusing the attention of competing politicians, journalists, and professionals on the management of the schools;

The decay of increasing returns from task complexity and diversity in the largest organizations; and

The political conflict and stress factors which constrain innovation through representative institutions such as elected school boards.

Our new set of expectations for the analysis and prediction of decisions to innovate is more specific, more directed toward organizational behaviors and incentives, and more appropriate for yielding hypotheses which apply directly to public organizations other than schools. Ultimately, our causal model of innovation decisions may encompass all public organizations, taking schools as just a part of a broad scheme. Now, of course, school organizations are the institutions whose recorded behaviors allow us to investigate the institutional roots of innovation.

Appendix 1

NUMBER OF OBSERVATIONS IN SUMMARY GROUPS
FOR DIAGRAMS 1, 2, 3

ln (Enrollment)	Superintendent's Tenure		
	0-1 2-8 9-41 Diagram 1 (All Districts)	0-1 2-8 9-41 Diagram 2 (Suburbs)	0-1 2-8 9-41 Diagram 3 (Other Districts)
5.7 - 6.9	12 37 23 (6.50)	5 17 13 (6.44)	7 20 10 (6.56)
6.9 - 7.6	16 57 24 (7.29)	7 23 10 (7.23)	9 34 14 (7.33)
7.6 - 8.0	20 35 13 (7.82)	13 18 6 (7.81)	7 17 7 (7.82)
8.0 - 8.25	17 38 22 (8.12)	7 22 13 (8.13)	10 16 9 (8.8.10)
8.25 - 8.5	21 36 18 (8.38)	16 18 15 (8.38)	5 18 3 (8.37)
8.5 - 8.8	21 30 20 (8.67)	11 23 9 (8.66)	10 7 11 (8.68)
8.8 - 9.2	26 46 23 (9.00)	16 20 11 (8.98)	10 26 12 (9.01)
9.2 - 9.5	15 31 22 (9.35)	4 17 9 (9.34)	11 14 13 (9.36)
9.5 - 9.8	15 20 8 (9.63)	11 10 3 (9.63)	4 10 5 (9.63)
9.8 - 10.1	13 19 8 (9.93)	6 8 6 (9.93)	7 11 2 (9.94)
10.1 - 10.7	13 26 15 (10.38)	6 8 7 (10.35)	7 18 8 (10.40)
10.7 - 14.0	31 41 8 (11.41)	4 17 5 (11.20)	27 24 3 (11.51)

NOTE: the mean value of ln (Enrollment) for each summary group appears in parentheses under its respective row of summary group sizes.

Appendix 2

WEIGHTED REGRESSIONS FOR GROUPED, SUMMARY DATA, COMPUTED FOR 840 FULL-INFORMATION DISTRICTS

A. REGRESSION FOR 36 DATA POINTS IN DIAGRAM 1

Percent submitting a proposal =

$$-.601 + \underset{(.014)}{.110} \times \ln(\text{Enrollment}) + \underset{(.053)}{.256} \times \text{Tenure 0 or 1} + \underset{(.047)}{.130} \times \text{Tenure 2 to 8}$$

$N = 36$

$R^2 = .747$

$F_{3,32} = 31.4$ $(p < .001)$.

B. REGRESSION FOR 72 DATA POINTS IN DIAGRAMS 2 AND 3

Percent submitting a proposal =

$$-.379 + \underset{(.013)}{.102} \times \ln(\text{Enrollment}) - \underset{(.035)}{.290} \times \text{Suburb} + \underset{(.049)}{.246} \times \text{Tenure 0 or 1} + \underset{(.043)}{.119} \times \text{Tenure 2 to 8}$$

$N = 72$

$R^2 = .734$

$F_{4,67} = 46.3$ $(p < .001)$.

NOTE: Each observation is weighted by the number of observations it summarizes; these values are given in Appendix 1.

Appendix 3

REGRESSION COEFFICIENTS AND (t-RATIOS) FOR REGRESSIONS ON 'SUBMITTING INNOVATIVE PROPOSALS' OF VARIOUS COMBINATIONS OF VARIABLES, COMPUTED FOR 1243 OBSERVATIONS

	Untransformed Specification	Transformation: ln (Enrollment)	Transformation: Poverty Dummy
Constant	.179	-.565	.203
Enrollment	.005 (1.67)	.120 (9.42)	.0005 (1.70)
Central City	.232 (5.27)	-.020 (-.40)	.225 (5.10)
Suburb	-.030 (-.91)	-.114 (-3.46)	-.060 (-1.98)
Poverty	.158 (1.27)	.125 (1.05)	-.063 (-1.80)
Fiscal Status	.031 (1.03)	-.019 (-.63)	.037 (1.22)
Board Selection	.046 (1.05)	-.013 (-.30)	.066 (1.50)
Tenure 0 or 1	.299 (7.29)	.198 (4.83)	.285 (7.03)
Tenure 2 to 8	.160 (4.71)	.071 (2.09)	.150 (4.52)
Tenure 9 to 41	.020 (.49)	-.062 (-1.53)	.010 (.24)
R^2	.111	.169	.112
F	17.2	27.9	17.4
Constraints, Degrees of Freedom	9,1233	9,1233	9,1233

NOTE: the Poverty dummy variable is coded 1 for districts with between 20 and 40 percent poor children, 0 otherwise.

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2. *Ibid.*, p. 9.

3. *Ibid.*, p. 1.

4. I interviewed several staff members of the Office of Education who were familiar with the first years of Section 306, in August 1973. At that time I reviewed the applications submitted in response to the December 1970 announcement. I also duplicated and subsequently reviewed the narrative section of each proposal, which describes the aims and methods of the proposed project.

5. Aiken, Michael, and R. R. Alford, "Community Structure and Innovation: The Case of Public Housing," *American Political Science Review*, Volume 64, 1970, pp. 843-864. Aiken and Alford do *not* consider the subject of innovations in education, and they explicitly *do* include implementation behaviors in their dependent variables (p. 843). My criticism, therefore, is more of what they should have done than of what they did; but I think their concept of innovation creates some misleading results.

6. See note 4 above.

7. This is an unpublished paper completed in April 1973 at Yale University.

8. U.S. Office of Education, "Log of the CPIR Sample," unpublished computer output, 1973.

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11. U.S. Office of Education, *Education Directory: 1970-71 Public School Systems*, Government Printing Office, Washington, D.C., 1971.

12. Bureau of the Budget, *Standard Metropolitan Statistical Areas 1967*, Government Printing Office, Washington, D.C., 1967.

13. "1970 Elementary and Secondary General Information Survey," *op. cit.*

14. American Association of School Administrators, *1970 Roster of Members* (Corrected to October 1, 1970), Washington, D.C., 1970.

15. A useful conversational treatment of the grouping issue is given in H. M. Blalock, Jr., *Causal Inferences in Non-Experimental Research*, University of North Carolina Press, Chapel Hill, 1964, pp. 105-107. A theoretical review is provided in J. Johnston, *Econometric Methods*, Second Edition, McGraw-Hill Book Company, New York, 1972, pp. 228-238.

16. Weighting of variables which use grouped observations is treated in Johnston, *op. cit.*, pp. 228-230.

17. Kort, Fred, "Regression Analysis and Discriminant Analysis: An Application of R. A. Fisher's Theorem to Data in Political Science," *American Political Science Review*, Volume 67, 1973, pp. 555-559. Discriminant analysis is discussed in Johnston, *op. cit.*, pp. 334-340.

18. Tukey, J. W., *Exploratory Data Analysis*, Volume One, Limited Preliminary Edition, Addison-Wesley Publishing Company, Reading, Massachusetts, 1970, Chapter 10, p. 11.